Principal Groundwater Contaminants: Their Sources, Environmental Fate, Health Effects and Treatment Options

Contaminant (with examples)	Sources	Environmental Fate	Health Effects	Treatment Options
Solvents • naphthalene • toluene • benzene • tetrachloroethylene • trichloroethane • vinyl chloride	• Industry • vehicle maintenance • metal parts cleaning, degreasing • dry cleaning • furniture finishing • printing • gasoline additives • cleaning products • improper disposal in septic systems • septic tank cleaners	Surface: volatilize readily Soil: resist biodegradation; breakdown products may be toxic Groundwater: very mobile and persistent; some are denser than water and move downward to bedrock	Vinyl chloride and benzene are known human carcinogens; some others, especially chlorinated solvents, are suspected carcinogens; can cause a range of other health effects, including central nervous system effects, irritation of respiratory and gastrointestinal systems.	Evaporation by aeration (public supplies); carbon filtration
Petroleum Products • gasoline • motor oil • fuel oil	• vehicle maintenance • automobile service stations • heating fuel tanks • industrial machinery	Surface: light oils, gasoline volatilize readily Soil: low solubility, may persist in pore spaces and be leached into groundwater by precipitation for long period Groundwater: gasoline and light oils float on water table; heavy oils less mobile; move down to bedrock	Petroleum products can produce a variety of toxic effects, including central nervous system damage, irritation of respiratory and gastrointestinal system; benzene, a gasoline additive, causes leukemia in humans.	Same as solvents
Pesticides • chlorinated hydrocarbons (chlordane, EDB) • carbamates (Aldicarb) • organophosphates (Malathion)	• agriculture • lawn applications • pesticide manufacture, storage	Highly variable: chlorinated hydrocarbons tend to be very persistent, highly susceptible to leaching, and produce toxic breakdown products; other pesticides may be degraded to inert forms or bound to soil particles	Wide range of toxicity to humans; many pesticides are highly toxic, cause central nervous system damage, or are suspected carcinogens.	Some can be removed by carbon filtration or aeration

Nitrates	• agriculture (fertilizers and manures) • lawn care • septic systems • sewage treatment and collection systems	Soil: highly soluble, very mobile; can be taken up by growing plants Groundwater: very mobile and persistent	Nitrates react with blood hemoglobin, impairing ability to transport oxygen; infants can be fatally affected at relatively low concentrations.	Reverse osmosis (small quantities)
Biological Pollutants • bacteria • viruses • parasites	• septic and sewerage systems • agriculture (manures)	Soil: bacteria and parasites readily removed by soil filtration	Bacteria cause gastrointestinal diseases (cholera, typhoid, enteritis, hepatitis); viral disease from groundwater uncommon, but no good lab tests available	Disinfection by boiling, chlorination or other methods
Salt (sodium chloride)	• road salt storage and application • home water-softener backwash • salt water intrusion (near coast)	Soil: very soluble, highly mobile Groundwater: mobile and persistent	Excessive sodium intake has been linked with high blood pressure and hypertension.	Reverse osmosis (small quantities)
Metals • lead • chromium • silver • mercury • aluminum • iron • manganese	• metal finishing and metal working industries • photo and x-ray processing • printing painting • automobile radiator and body shops	Soil and Groundwater: metals readily removed by reactions with soil particles under neutral to basic conditions but soluble and mobile in acidic waters	Some heavy metals (e.g., lead, chromium) are highly toxic, cause developmental and nervous system effects; iron, manganese low in toxicity.	pH adjustment to neutralize water and filtration of precipitate
Acids/Bases	• industry • photo processing • printing • painting • automobile radiator and body shops	Soil and Groundwater: mobile and persistent except in presence of natural pH buffers (e.g., limestone)	Acids and bases are rarely a significant health hazard in themselves, but they affect the solubility of toxic metals.	pH adjustment